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Dimico, A., Isopi, A., & Olsson, O. (2017). Origins of the Sicilian Mafia: The Market for Lemons. *The Journal of Economic History*, 77(4), 1083-1115. <https://doi.org/10.1017/S002205071700078X>

**Published in:**  
The Journal of Economic History

**Document Version:**  
Peer reviewed version

**Queen's University Belfast - Research Portal:**  
[Link to publication record in Queen's University Belfast Research Portal](#)

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# Origins of the Sicilian Mafia: The Market for Lemons

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April 27, 2017

## Abstract

In this paper, we study the emergence of an extractive institution that hampered economic development in Italy for more than a century: the Sicilian mafia. Since its first appearance in the late 1800s, the reasons behind the rise of the Sicilian mafia have remained a puzzle. In this paper, we argue that the mafia arose as a response to an exogenous shock in the demand for oranges and lemons, following Lind's discovery in the late 18th century that citrus fruits cured scurvy. More specifically, we claim that mafia appeared in locations where producers made high profits from citrus production for overseas export. Operating in an environment with a weak rule of law, the mafia protected citrus production from predation and acted as intermediaries between producers and exporters. Using original data from a parliamentary inquiry in 1881-86 on Sicilian towns, the Damiani Inquiry, we show that mafia presence is strongly related to the production of oranges and lemons. The results hold when different data sources and several controls are employed.

**Keywords:** mafia, Sicily, protection, barriers to entry, dominant position

**JEL Codes:** K42, P48, N00.

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\*Corresponding author: Queen's University Belfast and QUCEH. Email: a.dimico@qub.ac.uk. Special thanks to Giuliano Isopi for excellent research assistance. We gratefully acknowledge comments from Gani Aldashev, Jean-Marie Baland, Michael Bleaney, Paolo Casini, Chris Colvin, Giacomo de Luca, Stefano Fenoaltea, Halvor Mehlum, Kalle Moene, Kyriacos Neanidis, Jean-Philippe Platteau, Oleg Shchetinin, Yves Zenou, and seminar participants in Nottingham, Brown University, Gothenburg, Leuven, Birkbeck College, the EEA-ESEM meetings in Malaga, the RES Conference in Manchester, the EBHS in Manchester, Namur, Oslo, Stockholm, York and Glasgow.

# Introduction

The Sicilian mafia is arguably one of the most infamous institutions in the Western world. After its first appearance in Sicily in the 1870s it soon infiltrated the economic and political spheres of Italy and of the United States and has, at times, been considered a serious threat to the rule of law in both countries. Although outcomes of the mafia's actions such as murders, bombings, and embezzlement of public money have been observed during the last 140 years, the reasons behind its emergence are still obscure.

In this paper, we study the rise of the Sicilian mafia using a unique dataset from the end of the 19th century. The main hypothesis is that the growth and consolidation of the Sicilian mafia is strongly associated with an exogenous shock in the demand for lemons after 1800, driven by James Lind's discovery on the effective use of citrus fruits in curing scurvy. Given Sicily's already dominant position in the international market for citrus fruits, the increase in demand resulted in a very large inflow of revenues to citrus-producing towns during the 1800s. Citrus trees, can be cultivated only in areas that meet specific requirements (such as mild and constant temperature throughout the year and abundance of water) guaranteeing substantial profits to relatively few local producers<sup>1</sup>. The combination of high profits, a weak rule of law, a low level of interpersonal trust, and a high level of local poverty made lemon producers a suitable target for predation. Neither the Bourbon regime (1816-1860), nor the newly formed government after Italian independence in 1861 had the strength or the means effectively to enforce private property rights. Lemon producers, therefore, resorted to hiring mafia affiliates for private protection and to act as intermediaries between the retailers and exporters in the harbors.

Our paper presents a conceptual framework that links the institutional setting of Sicily in the early 1800s with the specific characteristics of the market and production of lemons following the international boom in export demand. The main implications of our conceptual framework are tested using two data sets from Sicilian towns and districts gathered from a parliamentary inquiry conducted between 1881-86 (Damiani, 1886) and an additional one from 1900 (Cutrera, 1900). Our results indicate that mafia presence in the 1880s is strongly associated with the prevalence of citrus cultivation. No other crop or industry has a robust impact on mafia activity. The results continue to hold when we include several control variables, address a possible endogeneity issue using data on climatic conditions, and adopt two alternative dependent variables collected and coded from a later source.

Our paper relates to several different strands of literature<sup>2</sup>. First, is the literature on the historical emergence of an "extractive" institution that hampers economic development and that can appear, at critical junctures, in a country's history (Acemoglu, Verdier and Robinson, 2006; Acemoglu and Robinson, 2012). The mafia is undoubtedly an example of this, emerging during a critical period in the Italian history (i.e. Italian unification).

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<sup>1</sup>The high fixed costs were given by the sum of the cost of planting trees and waiting several years for them to grow, the need to build protective walls to keep thieves out, the system of irrigation, etc. Due to a large regional variation in the climate and soil suitability for growing lemons, the fixed costs of starting up a cultivation were very different across towns.

<sup>2</sup>Please see the working paper version for a more extensive review.

Our analysis though, departs from this strand, since we emphasize the economic or *market structure*-related factors behind mafia organization rather than its political origins (such as the role played by a weak and oppressive Bourbon state in Sicily with substantial social inequalities, as discussed further below).

Our results are also strongly associated with research on the “curse of natural resources” (see Van der Ploeg (2011) for a recent overview). We claim that the economic boom in international citrus demand, and the subsequent rise of Sicilian exports during the 19th century, are key factors behind the rise of mafia. This is also consistent with the more recent finding that windfall gains from natural resources are often associated with intense rent seeking and patronage politics. For instance, Sala-i-Martin and Subramanian (2003) argue that political corruption related to oil revenues hampered Nigeria’s growth for decades. Acemoglu, Johnson and Robinson (2004) show how mineral wealth in Zaire allowed President Mobutu to buy off political challengers. A recurrent theme in this tradition is that resource windfalls might actually destabilize and deteriorate institutions, if key groups in the society believe that predation is more profitable than production (Mehlum, Moene and Torvik, 2006; Congdon Fors and Olsson, 2007).

Another literature that our analysis connects with is the economic analysis of organized crime, which focuses on weak institutions, predation, and enforcement of property rights (Fiorentini, 1999; Grossman, 1995; Anderson, 1995; Skaperdas and Syropoulos, 1995; Skaperdas, 2001). Grossman (1995) and Skaperdas (2001) both consider mafia as an alternative enforcer of property rights. Using a model with two actors (a self-governing community and mafia) and potential robbers, Skaperdas (2001) shows that in the absence of an enforcer of property rights, mafia can represent a sort of second best solution<sup>3</sup>. Regarding the economic costs of organized crime, Reuter (1987) and Gambetta and Reuter (1995) analyze the effect of organized crime on the enforcement of cartel agreements in legal markets. De Feo and De Luca (2014) study how the mafia influenced the rise of the Christian Democratic Party.

Our paper is most closely related to Bandiera (2003). Bandiera’s main hypothesis is that the increase in land fragmentation following the Bourbon-era land reforms (1816-1860), provided the breeding ground for mafia protection: a higher number of land owners increase the need for private protection. In Bandiera’s model, a key feature is that protection of one producer generates a negative externality on other producers, since it makes them more likely to become objects of predation. In an empirical section where she uses information from the Summary Report presented to the Italian parliament by Damiani (1886), Bandiera (2003) concludes that land fragmentation is a significant determinant of mafia presence<sup>4</sup>.

While our analysis also identifies landowners’ demand for private protection as the main

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<sup>3</sup>The idea of a weak state and private protection is well illustrated by Don Calo’ Vizzini, one of the historical bosses of the mafia in Villalba. In an interview with Indro Montanelli, he said that “...*the fact is that in every society there has to be a category of people who straighten things out when situations get complicated. Usually they are functionaries of the state. Where the state is not present, or where it does not have sufficient strength, this is done by private individuals*” (Montanelli, 1949).

<sup>4</sup>The information available in the Damiani Inquiry (see Footnote 1) has previously been used also by other scholars studying the origins of the Sicilian mafia. See for instance Colajanni (1885, 1895), Hess (1973), Arlacchi (1986), Catanzaro (1992), Gambetta (1996), Dickie (2004) and Lupo (2011).

process through which the mafia was mobilized, we explicitly focus on the role of revenues from citrus production rather than on land fragmentation. We improve on Bandiera (2003) by using the original Damiani survey (1883) where *pretori* (lower court judges) provided answers on the causes of crime. This allows us to extend the analysis from the 70 towns located in the western part of the island (Bandiera, 2003) to almost all available Sicilian towns (143 in total) for which *pretori* provided answers. With this more complete sample, we find that *Land Fragmentation* indeed explains some of the variation in mafia presence. However, we also find that the most robust determinant of mafia activity is the production of citrus fruits.

Buonanno, Durante, Prarolo and Vanin (2015) also studies the importance of export markets (sulphur production) for mafia appearance using data from Cutrera (1900), a police officer in Palermo. Cutrera uses as sources Colajanni (1900), Alongi (1887) and other data from local police offices to create a map of Sicily where the intensity of mafia activity is outlined for every city<sup>5</sup>. Even though the data show figures on the level of mafia for most of the Sicilian cities at the beginning of the 20th century, they refer to a period of almost twenty years later than the Damiani Inquiry. In the meantime, mafia extended its activity to cities that initially were unaffected and hence, we believe that data from Cutrera are more appropriate for understanding the evolution of the mafia phenomenon over time<sup>6</sup>. Buonanno, Durante, Prarolo and Vanin (2015) find that sulphur production has a strong association with mafia presence in 1900. Our results show that citrus production explained the presence of mafia holds even when we use Cutrera’s data. In summary, we believe our focus on the importance of citrus production complements (rather than competes with) the findings in previous studies on the key roles played by land fragmentation and sulphur exports.

Our analysis is also related to a long tradition in anthropology, sociology and history on the Sicilian mafia. The classical contributions include early investigations from Villari (1875), Sonnino and Franchetti (1877), and Colajanni (1885, 1895). In recent years, the origin of Sicilian mafia has also been discussed in Gambetta (1996), Dickie (2004), and Lupo (2011)<sup>7</sup>. While Lupo (2011) and Dickie (2004) consider profits from the lemon industry in the Western part of the island as a pre-condition for the development of mafia, Gambetta (1996) focuses on the division of land resulting from the abolition of feudalism and other policies introduced by the Italian government after 1860 (i.e., the sale of land owned by the church and the crown before the unification). These policies opened a market for private protection, where the mafia acted as an incumbent.

The extensive literature discussed above provides plausible explanations for the rise of the Sicilian mafia. Yet, with the exception of Bandiera (2003) and Buonanno, Durante, Prarolo and Vanin (2015), it is still difficult to understand why we observe a substantial

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<sup>5</sup>Alongi (1886) and Colajanni (1900) themselves use the information available from the original inquiry. Therefore, their books represent a further elaboration of the results collected by the Damiani Inquiry, which could potentially add a bias in the data provided by Cutrera (1900).

<sup>6</sup>This is supported by Gambetta (1996), who argues that in the period between the late 1870s and late 1890s, the mafia evolved quite markedly as a result of “economic and political conflicts among local groups, in connection with the institutional change that affected Italy between 1869-1890” (Gambetta, 1996, pg.83).

<sup>7</sup>See Lupo (2011) for a general history and Monroe (1909) for a description of the agricultural practices in Sicily at the time.

variation in mafia activity across provinces experiencing very similar social, economic and political conditions. If a weak state, a high regulatory burden, and a lack of public trust are the factors that matter for the development of mafia, then we should not observe any province variation. However, this is not the case. Across counties and villages exposed to the same environment there is a notable difference in mafia presence: organized forms of crime initially appeared only in a small number of localities and then spread all over the region. The combined hypothesis of a resource boom under a weak rule of law advanced here not only complements existing theories of mafia emergence (for instance those focusing on political factors) but is also consistent with the timing of the rise of the mafia. It also allows us to explain the cross-regional variation across Sicily.

## Background

### Historical and institutional setting

Sicily is the largest island in the Mediterranean and, given its central position within the Mediterranean trade routes, has always been considered a strategic location . Its history is marked by continuous foreign domination. Having been colonized by Greeks during early antiquity, it was subsequently controlled by Romans, Byzantine, Arabs, Normans, Spanish and French. This long period of different foreign domination strongly shaped its social development. In fact, from the economic and institutional point of view, Sicily has been a lagging region in Italy.

The death of Fredrick II represents a turning point. In his effort to establish a modern and centralized state in Sicily, Fredrick II promulgated the Constitution of Melfi in 1231 which limited the jurisdictional power of princes and barons and empowered local magistrates who were responsible only to the king. As a result, princes and barons were responsible for civil justice only, while the king, through the appointment of local magistrates who remained in charge for one year was responsible for criminal justice.

However, with the death of Fredrick II, a period of political instability followed which led to an increasing decentralization of power to feudal lords who *de facto* established a *mero et mixto imperio* in which the king delegated the political, administrative, fiscal, military, and judicial power to the feudal lord. Between 1583 and 1748 the Sicilian population under the direct jurisdiction of feudal lords increased from 44 percent to 58 percent (Benigno and Pharum, 2001). The weak and distant governance of the Bourbons only increased the prevalence of insecurity, providing the barons with unrivaled domination over local affairs (Blok 1975). As a result, they took into their own hands the business of protection appointing their own militia to maintain law and order and to supervise other employees, such as stewards, field guards, tax collectors, etc (Blok, 1975).

The French, who reigned over the island from 1805 to 1815, tried to modernize this archaic system by introducing, in 1812, a new constitution which abolished the feudal privileges and the primogeniture. However, the reform did not achieve the desired results given the financial inability of small scale owners to invest in land, which was auctioned by parishes. As a result,

the feudal structure was perpetuated and barons retained their power. Indeed, the reform may have made the situation worse. Beside feudal privileges, the reform also abolished civic, social, and judicial duties of feudal lords, transforming the feud in a simple allodial land (Colajanni, 1900).

The period 1812-1860 was marked by popular revolts and the spread of brigandage, during which several feudal lords fled, delegating the responsibility for the large estates to the *gabellotti*, who acted as mediators between landowners and the proletariat. From having been simple tenants (renting the land from landowners and subletting it to peasants), many *gabellotti* became landowners following the auctioning of feudal land after 1812. To maintain order and to avoid being plundered by brigands they hired their own private guards, referred to as *campieri*. According to Colajanni (1900) the easiest way to hire a *campiere* was to recruit him from the *brigands*. Such an arrangement secured the estate against attacks from the *campiere*'s former companions. The coalition between *gabellotti*, *campiere* members of the *compagnia d'armi* (a private militia hired by the Bourbon government to maintain order in the countryside), and *brigands* triggered a system of corruption and intimidation such that landowners who could not afford to hire a *campiere* became the target of brigands and they had to pay (*componende*) to get back stolen goods and livestock. We argue that this adverse institutional environment provided the breeding ground for the organization which would become known as the *mafia*.

## The production of lemons

According to available historical evidence, the bitter orange<sup>8</sup> (*Citrus higaradia*) was introduced in Sicily by the Arabs in the 10th century. Because of favorable weather conditions, the plant spread quite quickly and bitter orange started growing wildly almost all over the island. The island's hot coastal plains, together with the exceptionally fertile soil, containing a limestone base with heavy coatings of lava, were well-suited for growing citrus fruits. Lemon trees however have a very poor tolerance for extreme climatic conditions. In order to grow and develop they require temperatures between 13-30 °C where the average temperature in Sicily is between 10-22 °C. Flowers (and fruits) may die after few minutes of exposure to temperatures below 1-2 °C. The intolerance to frost explains the geographic concentration and location of the trees on the island. Areas slightly above the coastline are more suitable because of the relatively low variation in daily (and annual) temperature than locations in the mountains, where the variation in temperature is greater.

In the absence of a strong national and international demand before the 19th century, lemons were mainly used for decorative purposes and for extracting essences. It was an aristocratic symbol of wealth. According to the detailed description of lemon production in Powell (1908), the production of lemons in 19th century Sicily started with the sowing of bitter orange seeds in spring in small seed beds under the bearing lemon trees. After one year from the seeding, the small trees were transplanted in small clumps at a distance of

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<sup>8</sup>The bitter orange is the wild plant which is normally used as a rootstock in groves of lemons and sweet orange.

about 60cm from each other. When the plant reached a height of almost a meter, the tree was transplanted, to the groves at 3-4 meters of distance from each other. The quality of the lemons largely depended on the quality of the soil. "The lemons produced on the lighter soils are rougher in texture and poorer in quality than the lemons from the heavier lands. They ripen earlier and are said to have poorer keeping qualities" (Powell, 1908, p.21). Because of the lower quality, lemons planted on lighter soils were generally used for citrates (a soft drink) and essences, whereas lemons produced on heavier soils were exported.

Every one or two years dead branches were pruned. In order to keep the soil moisturized, the land was generally turned over with a short, heavy hoe twice a year. At the same time, land was fertilized either with natural or, in some cases, with chemical fertilizers. Because of water needs (plants need to be watered at least once every week) irrigation was practiced in almost all groves using the *noria*, a sort of horse powered mill which pumps water from the well into terracotta tile channels where the water was carried to the heads of the rows. Because flowering trees are extremely sensitive to frost, in the regions where the temperature dropped below zero, a system of trellises were built over the grove. Walls and fences were also used to protect the plant against the hot wind from Africa (*scirocco*).

Despite being seasonal, efforts by producers made it possible to harvest lemons at least twice a year. Products were, therefore, able to stay on the market for the entire year: in October, fruit that had an early maturation were collected, whereas fruit that matured in February were left on the trees as long as possible in order to extend their supply. The last fruit to go on the market were those maturing in summer time, though they were considered of a lower quality. Lemons were harvested from the trees when they were still green. In winter time, the fruits were placed in boxes and kept in underground storage rooms, where the lemons could complete the maturation process (Lupo, 1990) <sup>9</sup>.

The type of contracts signed between landlord and tenant/gabellotto represented variations of the sharecropping contract. Sonnino (*in* Lupo, 1990) documents a quite advanced type of contract proposed by the baron Turrisi to his tenants, where the tenant was allowed to keep 1/4 of the total output. However, this share could go up or down depending on the quality of the groves. When groves were of particularly high quality, the tenant's share was around 1/8 of the final output and it would go up to 1/2 in case of lower quality. The landlord provided the trees, the water and the fertilizers and the tenant was responsible for farming the land and for soil preparation. Usually, the contract lasted between 6-8 years, which is the minimum number of years for a lemon grove to become fully productive.

Given the uncertainty associated with the sharecropping agreement, it was, overtime, replaced by simple employment contracts according to which the landlord hired an employee (*castaldo*) on a fixed wage. The *castaldo* was in charge of the lemon grove and of the workforce that permanently worked on the land. Beside the wage, the *castaldo* could sometimes be allowed to live in a small house close to the landlord, having wood and access to the vegetables and cereals cultivated on the land. In some cases, mainly after some years of experience,

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<sup>9</sup>When an upcoming harvest of lemon promised to become particularly valuable, it would frequently attract thieves. Usually, very high walls were built around the groves and dogs were often employed to discourage potential bandits (Lupo, 1990).



he could even attain the role of legal representative of the landlord when citrus fruits were brought to the market.

The workforce supervised by the *castaldo* was typically a squad of about 15 people (Lupo, 1990). Their main responsibility was to pick fruits and then with extreme care, putting the fruits in baskets covered with blankets. Each basket, weighing around 8 kg (Lupo, 1990), was then moved into a larger area where (usually) a woman cut the stalks and started a preliminary selection of the fruits. Later, these baskets were again carried to storage rooms from where they would be transported to the closest harbor. The essence industry was somewhat similar. However, the procedure to extract the essence and the oil from the fruits was more complex and required extremely skilled workers. Usually, the warehouses where this sort of processing took place were situated very close to the harbor, giving rise to a whole new neighborhood where employees organized their lives around the industry (Lupo, 1990).

The key agents in the negotiations were the *sensali* (i.e. a broker that connected the lemon producers with the exporters in the harbor). Direct transactions between the producer and the retailer were unfrequent. *Sensali* and landlords could negotiate price and quantity at harvest time when the quality of fruits could be evaluated (i.e. spot contract). Otherwise they could negotiate the entire yield of the grove before the ripening season (i.e. future contract). This type of contract provided more guarantees and certainty to the producer. The spot contract was usually more popular among those producers who were in control of the market, who could rely on existing financial assets and who aimed at a higher price (Franchetti, 1876).

When an agreement was reached, a fruit was placed on top of the gate leading to the grove to signal the end of the deal and that such a grove was protected by the *mafia* which supposedly guaranteed that the property and its fruits were free of damage (Lupo, 1990). The *mafia* often also provided different forms of contract enforcement. In fact, because of the weak rule of law and the pervasive uncertainty associated with an environment dominated by informal relationships, *mafiosi* were often involved in the negotiations between brokers and producers, filling the legal vacuum and the lack of trust between different actors (Lupo, 1990). According to Franchetti (1876), the power of mafia in the area of Palermo became particularly strong in the decade after the unification of Italy with the *mafia* being involved in all the aspects of productions from the simple appointment of the *castaldo* (generally associated to the mafia) to the choice of workforce, the negotiations and enforcement of contracts.

## **The role of citrus in the Sicilian economy**

Despite its underdeveloped economy, Sicily in the 19th century was a leading producer of wheat, olive oil, wine and, above all, citrus fruits. International demand for lemons started to increase from the late 1700s when lemons and, in particular, lemon juice became a standard preventive treatment against scurvy. Scientific support for the theory that consumption of citrus fruits cured scurvy was established by James Lind, a British naval officer and surgeon,

in the latter part of the 18th century. Although Lind performed, according to many, the first controlled therapeutic trial of his time, it took time for his results to be publicly recognized and for his suggestions to be adopted by the Royal Navy. In the words of Baron (2009): “The Sick and Hurt Commission agreed to supply all naval ships on foreign service with lemon juice, extended in 1799 to all the ships on the British coast. Between 1795 and 1814 the admiralty issued 1.6 million gallons of lemon juice. Sweet lemons were imported, especially from the Mediterranean region turning Sicily into a vast lemon juice factory ”<sup>10</sup>.

When peace was restored in 1814, international trade began to grow again and the international demand for Sicilian lemons boomed. Table 1 gives exports of barrels of lemon juice and lemon fragrances from the harbor of Messina throughout the 19th century<sup>11</sup>. Over the period 1837-1850 the total exports of lemon juice increased from 740 barrels to almost 20,707 barrels. The exports of lemon fragrances (in pounds) went from 57,918 pounds in 1837 to almost 624,977 pounds in 1850.

**Table 1: Exports of lemon juice and fragrances from the harbor of Messina**

Production increased in the following years and the total surface area devoted to the citrus production went from 7,695 hectares in 1853 to 26,840 hectares in 1880 (Pescosolido, 2010). The expansion was a direct result of the large returns associated with the demand for lemons. Monroe (1909) estimates that revenues were almost \$200 per acre (in 1908 US dollars), providing a net profit of more than \$150 per acre <sup>12</sup>. Dickie (2004) describes the evolution of citrus production: “In 1834, over 400,000 cases of lemons were exported. By 1850, it was 750,000. In the mid-1880s an astonishing 2.5 million cases of Italian citrus fruit arrived in New York every year, most of them from Palermo. . . . “citrus cultivation yielded more than sixty times the average profit per hectare for the rest of the island”(Dickie, 2004, p.39).

From 1881-85, the quantity of citrus exported went up to almost 949,000 quintals (2.5 million cases approximately)<sup>13</sup>, compared to 250,000 quintals in 1850 (Pescosolido, 2010). In this period, a large share of production went to the US. A combination of factors contributed to this outcome: a favorable international context, elimination of exports duties, and a considerable improvement in transportation. Table 2 shows figures on the lemon trade between Italy and the US in 1898-1903. The left-hand side of the table shows the total Italian lemons exports and the relative percentage exported to the US. The right-hand side shows the total US lemons imports and the estimated percentage coming from Italy<sup>14</sup>. The average quantity of lemons exported from Italy (and therefore mainly from Sicily) over this

<sup>10</sup>For more insights on this see Baron (2009).

<sup>11</sup>According to Sestini (1779-1784) the harbor of Messina was the leading port in Sicily for citrus fruits (Bottari, 2006).

<sup>12</sup>Table A1 in the online Appendix reports the change in the distribution of land devoted to lemon trees in the South of Italy between 1853 and 1885.

<sup>13</sup>Quintals are converted in cases using the information from Powell (1908) according to whom 1040 lemons weigh almost 120kg (p. 29) and in a case there are almost 330 fruits (p. 10). As a result the average weight per case should be around 38kg

<sup>14</sup>These data should be evaluated with some caution given that the total Italian lemons exports refer to the calendar year, while the total US imports refer to the fiscal year (and the two do not coincide).

period amounts to 389 million pounds and the average share of fruit imported by the US is almost 34 percent of the total Italian production<sup>15</sup>. Calculating the total Italian exports to the US, we estimate that almost 78.4 percent of the total US lemons imports between 1898-1903 came from Italy. Besides the USA, the UK and Austria were two others large importers of lemons. Over the decade 1898-1908, the UK imported between 17.7 to 25 percent of the total Italian lemons exports, and Austro-Hungary imported between 14.4 and 22.8 percent (Powell, 1908).

## **Table 2: Total Italian exports of lemons and total United States imports**

Powell (1908) provides a quite detailed account of the costs and profits associated to the production of lemons. He suggests that *“a fair estimate of the cost of producing a crop on a bearing grove, including cultivation, irrigation, fertilization, pruning, and other operations up to the time of picking, is from \$25 to \$60 per acre (i.e., between 130 and 300 Italian lire per acre) ”*(Powell, 1908, p 33) . The average wage of men during the picking season was equal to about 1.5 lire per day. Powell (1908) estimates that an average man could pick almost 5,000 fruits per day. The average price of 1,000 lemons in 1908 was around 17 Italian lire, providing a revenue per worker of almost 85 lire per day against a marginal cost in terms of wage payment of 1.5 lire.

Compared to lemons, the costs for olive trees and for grapes were much lower. According to the Damiani Inquiry (1886) olive trees in the 19th century were generally grafted trees and besides pruning and tilling, there were no other substantial costs related to irrigation or protection from frost and wind. The situation was similar for grapes which developed from branches of grapevines that did not bring fruit in the previous year.

Estimates of the profit and costs associated with different crops are provided by the mayor of Bisacquino according to whom the average annual cost for a hectare of wheat is lire 88 producing a profit of lire 200. The cost of 1,000 grape plants is 60 lire, providing a profit of lire 50. Finally, the cost of 1,000 lemon plants is 2,000 lire for a profit of lire 14,000. The profit from a hectare of land cultivated with olives is almost lire 400 (lire 98 per hectoliter) but no costs are reported. Therefore, the annual cost for a thousand plants of lemons is almost 33 times larger than the cost for a thousand plant of grapes but the profit is almost 35 times higher than the profit from olives (the second most profitable crop). In summary, the fixed and marginal costs of lemon production were so much higher for lemon than for any other crop but so was profitability.

## **The rise of the mafia**

The origin of the word *mafioso* (and consequently *mafia*) is found in the Arab language where the word *marfud* used to mean *swindler* or *cheater* (Lupo, 2011). In Italian, the original meaning of the word did not have a negative connotation but simply characterized somebody

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<sup>15</sup>The leading role of Sicily for the USA lemons market continued until the end of the 19th century, when the production in Florida became substantial.

who had *proud/courageous behaviour*. In fact, in the period before the unification of Italy - when the *proto-mafia* developed<sup>16</sup> (Lupo, 2011) - a *mafioso* was a man who had gained the respect of the local population by standing up against the brigands and the malicious crimes of the *campieri* and *compagnia d'armi* (Colajanni, 1900). This respect from the local population contributed to a legitimization of the *mafioso*, who received the support of the population given that their crimes were justified when committed against delinquents who were even worse than he (Colajanni, 1900). For this reason, almost everybody became directly or indirectly involved with the *mafia*, either by taking part in mafia activities or by covering and protecting those who committed such illegal acts (i.e. *omerta'*). It became a general practice to define men who showed courage and resolution as *mafiosi*.

The institutional setting on Sicily, based on corruption, crime, and private protection continued after unification in 1860. The Italian government was unable to take effective control of the island or to enforce the rule of law. As a result, the pre-unification system persisted. Actually, the situation became even worse as the discontent of the people increased due to the policies promoted by the new government which led to the uprising of Palermo in 1863. According to Lupo (2011), this is the period during which the *proto-mafia* turned into the new kind of *mafia* that would play an important role in the subsequent history of Sicily.

At the same time, there is no perfect account of its appearance. What we know about such groups is that they formed a secret society of sworn-in men who managed to overcome the collective action problem through various measures like brutal punishments in the case of defection<sup>17</sup>. Mafiosi were recruited from very diverse occupations in society, including gabellotti, peasants, doctors, and politicians and typically performed their daily jobs as an integrated part of society while also undertaking mafia activities. In the latter half of the 19th century, it is known that the key mafia activity was the protection of businesses but we do not know if this was their original purpose (Gambetta, 1996).

We argue that the combination of a generally weak rule of law, the boom in international demand for citrus fruits, and the risky and sensitive nature of lemon production together provided the breeding ground for the growth and consolidation of a mafia-type organization that could meet the challenges from producers, workers and exporters in the lemon industry. Our schematic framework is shown in Figure 1 which features two major types of developments relevant for understanding the rise of the mafia: one political and one specific to the citrus sector.

### Figure 1: Model of mafia emergence

<sup>16</sup>The proto-mafia refers to the perverse association between *gabellotti*, *campieri* and *compagnia d'armi* described in the section devoted to the Institutional Context.

<sup>17</sup>The first evidence of the presence of a secret sect (referred to as *cosca*) we are aware of is a note from 1872 by Dr. Galati, a landlord owning a lemons grove just outside Palermo, who wrote about a "man of honor" who made increasing use of violence and extortion to force him to sell his lemon grove (Dickie, 2004). When the Minister of Home Affairs learned about Galati's situation, he asked immediately for a written report from the chief of police in Palermo and then, ordered two parliamentary inquiries (the Bonfadini Inquiry in 1876 and later the Damiani Inquiry in 1881-5) to better understand the economic conditions and the level of crime in Sicily.

Despite the fact that the exact circumstances under which the mafia arose are not completely clear, we know that they thrived from offering protection to lemon and orange producers, from manipulating market prices, and from acting as intermediaries between producers and exporters. As the example of Gaspare Galati mentioned earlier shows, the protection services easily slipped into extortion where producers faced a direct threat of violence from the mafia if they refused to pay protection money. In line with standard models on the “hold-up problem”, it is natural to assume that in equilibrium, the mafia managed to extract rents from protection to an extent such that producers were almost indifferent about continuing their business or abandoning cultivation altogether<sup>18</sup>.

Why would the mafia focus on citrus production and not for example on the cultivation of wheat or wine? There are three basic reasons for the special importance of citrus fruit. First, the market value and profitability of citrus fruits was unusually high at the time, certainly much higher than for basic food crops like wheat. Second, the large fixed costs associated with irrigation and the long time before trees matured, made producers sensitive to predation. Third, the technology of predation on citrus fruits was relatively easy and cheap. According to Lupo (2011), a harvest of lemon fruits is very difficult to protect when the fruits are still on the trees. Picking a few hundred ripe lemons from a grove during a dark night should have been much easier for a thief than harvesting olives or grapes, not to mention wheat. As a consequence, lemon groves were more vulnerable to predation, despite the frequent construction of walls and the use of dogs and guards.

The straightforward hypothesis that arises from this framework is the following: In the period of the Damiani Inquiry in the 1880s, after several decades of a gradually growing production and exports of oranges and lemons in Sicily, the mafia should mainly be observed in local communities with citrus cultivation. More specifically, there should be a positive relationship between the dependent variable (mafia presence) and the main independent variable (citrus cultivation) in a cross-section of Sicilian local communities. Our framework suggests that natural control variables that might confound the analysis of a causal effect from citrus production to mafia presence are land ownership patterns and the production of other crops.

## Data

### Data from Damiani (1886)

The data used come from the Damiani Inquiry (1886),<sup>19</sup> which was part of a larger inquiry, approved in March 1877 and proposed by Stefano Jacini, that aimed at assessing the conditions of the agricultural sector and the conditions of peasantry in every region of Italy. Abele Damiani was an MP for the region Sicily. The Damiani Inquiry represents one of the earliest and most important primary sources about the economic and social conditions of

<sup>18</sup>For a general analysis of the hold-up problem, see for instance Hart and Moore (1988).

<sup>19</sup>Caltanissetta is the only province missing in our sample because files for this province were no longer available in the archives.

Sicily in the 1880s<sup>20</sup>.

Data both at town and district level (*mandamento*)<sup>21</sup> are collected for the seven provinces in which Sicily was split at the time of analysis (Caltanissetta, Catania, Girgenti, Messina, Palermo, Syracuse, and Trapani) for a total of 143 observations<sup>22</sup>.

The section of the Inquiry that matters to our analysis is comprised of two parts. The first discusses the situation of the agricultural sector, with particular reference to tax burden, wages, the kind of crops produced, and the relations between peasants and landlords (i.e., tenancy contracts, fractionalization of land, etc.). Questionnaires were sent out to almost 357 mayors of whom less than half provided complete information<sup>23</sup>.

The second part of the Inquiry provides information on the moral and social conditions of peasants. Questionnaires were sent to 179 *pretori* (lower court judges)<sup>24</sup>. In this section, we focus on the type/level of crime in the region. The question asked was: “*What is the most common form of crime in the district? What are their causes?*” We coded as the dependent variable a binary dummy, *Mafia*, for whether the *pretore* of the town recognizes mafia as the most important source of crime in the district<sup>25</sup>.

Bandiera (2003) and Buonanno, Durante, Prarolo and Vanin (2015) opted for a different dependent variable: an ordinal variable for the intensity of mafia collected from the Summary Report that Abele Damiani sent to the Italian parliament on the basis of the original Inquiry. However, in the original Inquiry it emerges that very few *pretori* mention the intensity of mafia (less than one tenth). Since the origin of the additional information is unclear, we prefer to use to the original document, which appears to be more accurate<sup>26</sup>.

There are potential concerns with the data on mafia presence. First, the mafia could still be present in a district even though the *pretore* did not list it as the most common form of crime. It is indeed possible that some districts had mafia activity, even though the *pretore* did not report it as being a major crime. This problem may slightly affect our results.

Second, if *pretori* were themselves mafiosi and they were likely to understate the presence of mafia. The answer to this question is most likely to be no although there is no conclusive evidence in either direction. *Pretori* were directly appointed by the Minister of Justice by a *Regio decreto* (royal order) and any other aspect concerning their career was subject to an

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<sup>20</sup>The Inquiry is still available from the Archive of State in Rome, even though the condition of manuscripts is not perfect and some pages are very hard to read.

<sup>21</sup>A *mandamento* is a judicial district of competence of the *pretore*, a lower court judge.

<sup>22</sup>Syracuse became province in 1865 replacing Noto, which was a province at the time of the unification in 1861. Except for mafia activity, all the information regarding Caltanissetta comes from the Summary Report that Abele Damiani presented to the Parliament because the original handwritten copy of the Inquiry has never been catalogued in the Archive of State in Rome.

<sup>23</sup>For unknown reasons, differently from the other provinces, the folder for this section on the province of Caltanissetta never reached the Archive of State in Rome and therefore, it was never catalogued there. In order to get data for the agricultural conditions for this province, we use the information available from the Summary Report that Damiani presented to the Parliament, which has also been used by Bandiera (2003) and Buonanno et al. (2015).

<sup>24</sup>There are much fewer *pretori* than mayors since the *pretura* is only present in larger provinces and one *pretore* often serves several towns.

<sup>25</sup>Data on mafia are available for 162 districts, but when merged with the independent variables the largest sample covers 143 districts

<sup>26</sup>*Pretori* were lower court magistrates. Because of their role, their information on criminal activity can be considered the most indicative.

evaluation made by a committee of experts belonging to the local Court of Appeal. For the first 10 years of their career, *pretori* changed district (*mandamento*) very often, which may have restricted their possibilities of connecting with the local environment<sup>27</sup>.

Third, did the *pretori* have a general understanding of what the term *mafia* implies? This indeed appears to have been the case. In the 1880s, the word *mafia* was already used to indicate a criminal organization, at least since 1863, when a comedy titled “*I Mafiusi di la Vicaria*” was shown in Palermo. Also, in 1865 the prefect of Palermo (Filippo Gualterio) used the word *mafia* in a private document to identify the criminal organization and later, in 1871 mafia membership became a public law offence. We, therefore, believe it highly unlikely that there was only misinterpretation<sup>28</sup>.

In Figure 2 we show the local distribution of mafia in our sample. On average, the 36 percent of towns were strongly affected by mafia which means that almost 51 out of the 143 towns had mafia listed as the most common form of crime. Girgenti is the province with the highest presence of mafia, where 14 out of 17 towns have strong mafia presence. In Trapani, the mafia operates in 6 out of 15 towns, and in the Caltanissetta province in 7 districts out of 16. In almost one third of the districts in Palermo (mainly those in the Conca d’Oro) and Catania provinces there is some form of mafia presence. Messina and Syracuse are the ones with the lowest incidence. These statistics (reported in Table 3) are also consistent with Colajanni (1885)<sup>29</sup>.

**Figure 2: Mafia and non-mafia towns in Sicily in the 1880s**

**Table 3: Distribution of mafia and agricultural production across provinces in 1881-86**

The independent variables we employed in the analysis can be divided into three groups. Colajanni (1885), Dickie (2004), and Lupo (2011) identify the profitable production of goods as important determinants of mafia presence. For this reason, the first group of independent variables includes *Citrus*, *Wheat*, *Olives*, *Grape* and *Sulphur*<sup>30</sup>. Given that the Inquiry does not provide information on hectares per crop for every *mandamento*, we decided to use a dummy variable (only recording whether the crop is predominant or not) in order to

<sup>27</sup>From another question of the survey it emerges that many *pretori* complained about administering justice without the cooperation of locals, since in several trials witnesses did not testify because of mafia’s retaliation or collusion with the mafiosi. According to Pezzino (1990), the *pretore* in Bagheria said “*There is a tendency to deny the truth. People does not answer truthfully, they deliberately lie either because of mafia or because of money or because they are scared*”.

<sup>28</sup>As long as the error term is not correlated with independent variables, there is no reason to believe that these problems will affect estimates. This is important for our analysis given that the possible misinterpretation of the question is likely to be distributed randomly across towns. It seems reasonable then to assume that the independent variable that we base our analysis on (whether a city/village produces citrus) is not correlated with the measurement error, providing us with unbiased estimates.

<sup>29</sup>Using information available in Damiani (1886), Colajanni identifies three macro-regions on the basis of economic and social conditions. The first region includes the province of Catania and Messina, where there were good economic and social conditions. The situation was slightly worse in the provinces of Syracuse, Trapani, Caltanissetta, and Palermo. The third region includes Girgenti, where both economic and social conditions were very poor and there was a high level of crime.

<sup>30</sup>The full list reported in the Inquiry for all the Sicilian region has many more crops and plants but we decided to include only 3 other than citrus on the basis on their relevance.

minimize the potential measurement error. The question we draw on for data in the Damiani Inquiry is: “Which is the dominant crop produced in the city?”. Mayors listed more than one crop (for a few cities they also reported quantities) and, because of that, dummies are not mutually exclusive. Whenever possible this information has been double checked with Question 8 which asks a better picture on dominant crops<sup>31</sup>. For example, for the town of Agira, the mayor does not list citrus as a dominant crop but then he argues that the total production of lemons is 400,000 units, providing an average revenue per hectares of about 592 lire<sup>32</sup>. Therefore, we decided to recode the variable using this additional information.<sup>33</sup>

Because data on citrus production plays a key role in our analysis, in a couple of instances where the Inquiry has ambiguous information (or no information is available), we used the data from Di Vita (1906) to complement the Damiani Inquiry.<sup>34</sup> Di Vita (1906) also provided data on sulphur mines and we used that to code this variable. As argued by Colajanni (1885), sulphur mines are almost exclusively concentrated in the province of Girgenti (12 out of 17 towns). Outside Girgenti, there are 5 mines in the province of Catania, 3 in Palermo, and 1 in the province of Messina and Trapani. Wheat production is high in the entire province of Girgenti, but is low in the province of Messina. Grapes and olives are almost equally distributed across the island. Our summary statistics seem to match the picture provided in Colajanni (1885) quite well<sup>35</sup>.

The second group of explanatory variables intends to control for the political status of each town and to assess the impact of policies implemented between 1812 and 1870 to increase the small-scale ownership of land. We consider three types of policies: i) the abolition of feudalism and the auction/allocation of land to smallholders; ii) the *enfiteusi*, a perpetual lease that allowed farmers to use the land as if they were owners; and iii) the seizure of Church-ruled territories and the consequent land auctions, which occurred after Italy’s unification. For each city, mayors provide information on the effectiveness of these policies in increasing land fragmentation. We use this information to code a dummy variable which is positive in case of reported effectiveness<sup>36</sup>. According to our data, highest effectiveness was reached in the Caltanissetta, Girgenti, and Catania areas, where the *latifund* was dominant. In the provinces of Palermo and Caltanissetta, the distribution of land appears to have been more fractionalized in relative terms, this was mainly due to the fact that the majority of cities in these provinces were ruled directly by the crown instead of the typical feudal hierarchy, dominant in other provinces. As a consequence, fractionalization policies had little effect in increasing private ownership among peasants because land was already

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<sup>31</sup>The reason we do not use average production (Question 8) as an explanatory variable is because this information is not available for several towns. In addition, the answer is not always comparable. Sometimes mayors report the monetary value of the production, while some others they report number of fruits per tree, or the number of fruits per hectare, or the number of trees per hectare.

<sup>32</sup>To understand the economic relevance of this number, we can compare these revenues with the average revenues per hectare of wheat (which the main crop listed) which is 50 lire.

<sup>33</sup>Controversial cases are reported in the Read-me file.

<sup>34</sup>Di Vita (1906) is a geographical dictionary which reports statistical information about Sicilian towns in the 19th century. Part of the information reported in Di Vita is based on the Damiani Inquiry itself.

<sup>35</sup>Table A3 in the online Appendix reports Summary Statistics.

<sup>36</sup>The dummy is coded one if the mayor argues that the policy has had an effect on the fractionalization of land.



fractionalized<sup>37</sup>.

Regarding land distribution, fractionalization is high in almost 50 towns and relatively low in 45 towns<sup>38</sup>. The questions asked were: “*What is the dominant scale of the plantation? And what is the fractionalization of land?*” The scale of plantation tends to be relatively high in Palermo, whereas in the other provinces its percentage is around 33 percent. Small-scale plantations are fairly common in all provinces, but particularly in Trapani, Messina, and Catania. Girgenti and Caltanissetta instead are the provinces with the lowest number of small-scale plantations<sup>39</sup>.

## Data From Cutrera (1900)

Cutrera (1900) is the second source of data on Mafia we use. Using information from police offices and newspapers, Cutrera drew a detailed map of the intensity of mafia in Sicily in 1900. Therefore, for each town, we code the intensity of mafia activity using an ordinal variable ranging from 0 (no mafia) to 3 (high intensity of mafia)<sup>40</sup>. This alternative source presents some issues. First, this data source records the level of mafia in 1900, more than 20 years later than the Damiani’s Inquiry. During these two decades, it is reasonable to assume that the mafia spread for reasons different from the ones that determined its emergence (for example, internal conflicts)<sup>41</sup>.

Second, Cutrera’s data cover only towns with and without mafia for East Sicily (provinces of Messina and Syracuse). For the remaining provinces (i.e. Palermo, Girgenti, Trapani), the author reports only towns with mafia, without providing any information about the ones missing, that is whether they are not mentioned because there is no mafia or because there is no information available. Because we cannot disentangle these two motivations, we decided to use two different coding strategies: i) We code a variable of mafia intensity for towns reported in the map following Cutrera’s coding rule; ii) we use the spatial distribution of mafia in order to interpolate levels of mafia activity for towns where information have not been reported. We assume that towns that are in the neighborhood of others with a high mafia intensity are likely to be also affected by some sort of mafia activity. As a result, we can use an inverse distance matrix to interpolate data for those towns for which there is no information on mafia activity. The level of mafia activity depends therefore both on the intensity and on the distance from neighboring cities where mafia is present. The results of this interpolation are shown in Figure 3. White areas denote towns with a low intensity of mafia (between 0 and 0.69), whereas black areas denote towns with a high intensity of mafia (between 2.25 and 3).

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<sup>37</sup>Information on the actual distribution of land, ownership and tenancy contracts are provided in Section Two of the Inquiry

<sup>38</sup>The Damiani Inquiry (1886) is the source for these data, except for Caltanissetta, whose data come from Damiani’s Summary Report. Table A4 in the online Appendix shows summary statistics

<sup>39</sup>Most of the time, mayors answered that a large, a medium, and a small scale are dominant, therefore the sum of the three variables is larger than one.

<sup>40</sup>The dependent variable is coded in the following way: 0 if there is no mafia; 1 if there is low intensity mafia; 2 if there is a medium intensity mafia; 3 if there is a high intensity mafia.

<sup>41</sup>See Gambetta (1996) for a discussion of the diffusion of mafia in the period 1880-1900.

### Figure 3: Mafia interpolated using an Inverse Distance Weighting

We merge this source with data on crop suitability from the FAO GAEZ <sup>42</sup>. We collect data for the three main crops produced in Sicily (lemon fruits, olive and wheat). Data on grape suitability and sulphur is not provided by the FAO GAEZ. For this reason we integrate data from the FAO GAEZ with dummies on grape production from Damiani (integrated with data from Di Vita, 1906) and sulphur mines from Di Vita (1906)<sup>43</sup>.

To minimize the risk of omitted variable bias, we use a large set of climatic and geographical indices related to factors which may affect agricultural production, and hence mafia. From the FAO GAEZ, we include indices for the median altitude, inland water scarcity and natural soil fertility (natural soil nutrients). We complete the list of independent variables by adding: i) spatial data on distance from the coast (source the NASA Ocean Biology Processing Group<sup>44</sup>) ii) data on soil neutrality (pH) from the FAO Geonetwork<sup>45</sup>.

## Econometric analysis

### Specification

We consider a simple model in which the probability of mafia depends on the prevalence of citrus production and other covariates. The baseline OLS model to be estimated can be written as:

$$M_{i,p} = \beta_0 + \beta_1 Citrus_{i,p} + \beta_2 Z_{i,p} + \eta_p + \mu_{i,p} \quad (1)$$

The main explanatory variable is an indicator for citrus production in the municipality  $i$  and province  $p$ , which we denote by  $Citrus_{i,p}$ . Our key hypothesis is that  $\beta_1 > 0$ .  $Z_{i,p}$  represents a set of control variables suggested in our theoretical framework that may affect the probability of mafia such as the presence of other crops, land fragmentation, the degree of trust citizens have in the law, or the peripherality of each town. Finally,  $\eta_p$  represents provincial fixed effects that may be correlated with the error term  $\mu_{i,p}$ .

### Results using data from Damiani

We present the OLS estimates with mafia presence in the 1880s as the dependent variable in Table 4. We start by estimating a simple model, where mafia presence in the 1880s depends only on variables capturing the economic activity of the town, the dummy for *fractionalization policies*, and a dummy for large scale production given that large fixed costs related to investment in irrigation (*norie*) were much more likely to be sustained in

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<sup>42</sup>Global Agro-Ecological Zones - GAEZ: <http://www.fao.org/nr/gaez/en/>.

<sup>43</sup>Table A5 in the online Appendix provides descriptive statistics for the dependent variable and the most important independent variables.

<sup>44</sup><http://oceancolor.gsfc.nasa.gov/DOCS/DistFromCoast/>

<sup>45</sup>Geo-Spatial data from the FAO GeoNetwork are available from: <http://www.fao.org/geonetwork/srv/en/main.home>. As expected soil PH is quite largely correlated with soil fertility (correlation = 0.5) given that it captures one of the main factor of soil fecundity.

towns where the scale of the plantation was relatively large (because of the decreasing cost per hectare), making producers more vulnerable to a potential loss due to extortion. We then proceed by introducing additional variables to control for observables.

In column 1, the diffusion of the mafia significantly depends on citrus production. At the mean, the production of citrus increases the probability of mafia by 20 percent. The *Fractionalization Policy* dummy has also a strong significant effect on the probability of mafia presence, as does the dummy for large scale plantations which increases the probability of mafia presence by 25 percent. The latter reflects the perverse system of corruption and private protection which developed in the latifund as outlined in the institutional setting. In column 2, we re-estimate the same model but controlling now for province dummies to capture regional fixed effects: the same results still hold. In column 3, we drop the observations for the province of Caltanissetta in order to detect any potential bias due to a different source of data. The estimated effects, in column 3, are almost unchanged as are the coefficients and the t-statistics. In column 4, we change specification by dropping the non-significant variables (to prevent an excessive reduction of the degrees of freedom) and again the results still hold. In column 5, we use *Population density* which is normally used as a proxy of income per capita and urbanization and the variable is not significant.

Bandiera (2003) argues that the effect of fractionalization policies occurs through the increase in the number of small-owners private property which made them vulnerable. At the same time, it is also possible that the dummy for fractionalization policies captures the absence of public providers of protection (i.e. a landlord) after the abolition of feudalism given that the aim of these policies was to limit the power of landlords by redistributing land to private owners. In fact, even though private ownership did increase, the resulting fractionalization in former feudal cities never exceeded that in crown-ruled cities where land has always been fractionalized. Therefore, to better assess the effects of this control, in column 6 we also include a dummy variable for the degree of land fractionalization. The dummy variable *High land fractionalization* turns out to be not significant. As argued above, though fractionalization policies in former *feudal cities* had some effects in increasing private ownership, the overall effect was not large enough and land distribution was not more fractionalized than in former *crown-ruled cities*. As a result it is possible that the consequence of these fractionalization policies was to release on the open market a new commodity: the armed guards that used to work for the feudal barons (Franchetti, 1876).

The set of covariates specified in column 6 represents our preferred specification. In this model, the presence of mafia is significantly determined by the citrus production, the effect of policies for private ownership, and by the scale of the plantation<sup>46</sup>.

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<sup>46</sup>In Table A6 in the online Appendix, we perform a series of robustness checks entering to our preferred specification additional controls for: 1) the distance from Palermo and Mazzara del Vallo (to capture the distance from a well-known mafia-base center and the distance from the town where lemon plants were originally introduced by the Arabs); 2) a dummy variable *Feudal* to test whether this political system often associated with patronage and kinship relations matter; 3) the distance from the nearest railway station (collected from Di Vita, 1906) as a measure of peripherality; 4) dummies for whether citizens trust, mistrust, or do not care about the law (the excluded group is whether they fear the law) from Damiani (1886); 5) the length of the tenancy contract which may be correlated with property rights. Among these variables, the length of the tenancy contract is the only one which results to have a statistical significant effect on mafia.

**Table 4: Mafia OLS Model**

As discussed above, our hypothesis is that the positive shock on the demand for citrus, following Lind’s discovery of the beneficial properties of citrus fruits in the treatment of scurvy, together with a comparative advantage in climatic conditions, gave Sicily a dominant position in the market for lemons. This in turn resulted in larger profits for some Sicilian producers in a weakly institutionalized setting, which created a demand for the mafia. Both the historical evidence of exports of citrus from Sicily and of prices of lemons in the 19th century, provided in Section 3 and OLS results In Table 4 support this hypothesis.

To provide additional robustness to our results, we re-estimate using an IV estimator<sup>47</sup>. The instrument for citrus is obtained using data on thermal regimes from FAO GAEZ. Among the several indicators on thermal regimes provided by the FAO GAEZ, we chose a measure of the frost-free period<sup>48</sup>. GAEZ estimates of climate and agro-climatic analysis are based on mean climatic data for the period 1961-1990. Therefore, we assume that large changes in climatic conditions have not occurred during the last two centuries.

The reason for using data on the risk of frost as an instrument for lemons is related to the minimal tolerance of the lemon tree to frost. The probability of frost, therefore, represents an important fixed cost for the production of lemons and we assume that lemon production will occur in towns characterized by a mild climate characterized by a shorter frost period and a lower seasonal variation<sup>49</sup>. High profits generated and more protection against potential losses required from local producers, play a key role on the level of mafia activity. Support for the use of this instrument is provided by the mayor of Bisacquino, who reports that the production of citrus is almost absent in his town because of adverse climate conditions.

The equations we estimate can be written as follows:

$$Citrus_{i,p} = \pi_p + \gamma_1 Frost_{i,p} + \beta_2 X_{i,p} + \mu_{i,p} \quad (2)$$

$$Mafia_{i,p} = \gamma_p + \beta_1 Citrus_{i,p} + \beta_2 X_{i,p} + \epsilon_{i,p} \quad (3)$$

The first stage regression (eq. 2) predicts the probability of lemon production, which then, in the second stage, affects the probability of mafia (eq. 3).

In Table 5, Panel A shows the results for the second stage regression<sup>50</sup>. The coefficients and levels of significance for the excluded instrument, together with diagnostic tests are also reported. In column 1, we report estimates for the IV and all variables in the baseline model

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However, this effect hardly impacts on the coefficient on *lemons*.

<sup>47</sup>The IV estimator provides a source of exogeneity to our Dummy for citrus fruits dealing with potential issues with the OLS estimator. In addition, an IV estimator, providing more variance, will also allow us to overcome the problem that the independent variable is a dummy, given that the estimator exploits the covariance between the dependent variable and the excluded instrument.

<sup>48</sup>The Frost-free period dataset refers to the number of days during the year with low risk of early and late frosts (days with  $T_{mean} > 10^\circ C$ ). This dataset is the result of the calculation procedures of GAEZ Module I (Climate data analysis and compilation of general agro-climatic indicators).

<sup>49</sup>In terms of our model, the risk of frost would imply a relatively high *bi*.

<sup>50</sup>IV results depend on whether the exclusion restrictions is satisfied or not. For example it may be possible that frost also affects other crops. For this reason we tried a series of falsification tests in order to test whether there is a significant effect of frost on other crops (i.e. olive, grape, almond, wheat etc.). Overall we do not find any significant effect of frost on these other crops.

are statistically significant at least at the 5 percent level. *Citrus* increases the probability of mafia presence by almost 54 percent, *Fractionalization policies* by almost 24 percent, and *Large-scale plantations* by almost 22 percent. Diagnostic tests confirm the relevance of the instrument. The Cragg Donald F-statistics is well above critical values for weak instruments and the partial F-statistics from the first stage is well above 10, normally considered the threshold value for relevance of instruments with one endogenous variable (Stock and Yogo, 2005). We also report estimates from using an IV Probit: results (in column 2) are consistent with the IV estimates.

**Table 5: 2-SLS Estimates**

### Results using data from Cutrera (2000)

To test further the robustness of our empirical specification, we run the same regressions but using data on *mafia* from Cutrera (1900), merged with independent variables on crops suitability from the FAO/GAEZ.

In Table 6 we show the results. The dependent variable used in the first three columns is the mean intensity of mafia using Cutrera’s coding rule. Because of that, the sample is confined to the 289 towns for which the author provides data. The first model is estimated using an ordinal probit. The variable proxying the suitability for citrus is significant at 1 percent level. In column 2, we re-estimate the same model using an OLS estimator and in column 3, we control for spatial correlation of the error terms using Conley (2008) spatial HAC estimator. For both models, the variable for suitability for citrus turns out to be significant at 5 percent level at least and its standard error decreases quite significantly, when we control for spatial correlation.

In columns 4 and 5, we change the dependent variable and use our interpolated measure of mafia intensity, which allows us to expand the sample to the entire population of Sicilian towns. We regress this new measure of mafia intensity against the same independent variables using an OLS (column 4) and a spatial HAC estimator (column 5). In both models, citrus suitability has a significant and positive effect on the intensity of mafia. In addition, the coefficient on citrus suitability remains quite stable (close to 1.2) compared to the other smaller sample. Overall, one standard deviation in suitability to citrus increases the intensity of mafia by almost 1.3 percent.

**Table 6: Mafia Intensity and Suitability to Citrus**

## Conclusions

Understanding how socially inefficient institutions arise and persist is a key issue in economic history. In this paper, we have investigated the origins of the Sicilian mafia. Unlike existing works that emphasize political and historical factors, our analysis identifies the importance of an exogenous shock in the international demand for lemons. The extraordinary revenues that certain producers received, combined with the general political insecurity and weak

rule of law, provided an ideal breeding ground for the emergence of a mafia that provided protection and acted as intermediaries.

The empirical analysis, using data from two sources, shows that the presence of mafia is strongly related to the production of citrus fruits. The results continue to hold when we include several control variables, address a possible endogeneity issue and employ two different dependent variables. We believe that our results contribute to shedding light on the emergence of one of the most harmful economic institutions in Europe during the modern era.

## References

- [1] Acemoglu, D., T. Verdier, and J. Robinson, 2004. “Kleptocracy and Divide-and Rule: A Model of Personal Rule”, *Journal of the European Economic Association* 22(2-3), 162-192.
- [2] Acemoglu, D., S. Johnson, and J. Robinson, 2006. “Institutions as a Fundamental Cause of Long-run Growth”, in *Handbook of Economic Growth*, Vol 1, Part A, 385-472. Edited by P. Aghion and S. N. Durlauf, 2005 Elsevier B.V
- [3] Acemoglu, D. and J. Robinson, 2012. *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*. New York: Crown Publishing Group.
- [4] Agenzia del Demanio, 2008. *Beni Confiscati Alle Mafie*, Minister of Home Affairs Report.
- [5] Alongi, G. 1886. *La mafia nei suoi fattori e nelle sue manifestazioni: studio sulle classi pericolose della Sicilia*, Bocca Editori, Torino.
- [6] Anderson A., 1995. *Organized Crime, Mafias and Governments*, in Fiorentini, Gianluca and Peltzman, Sam (eds), *The Economics of Organized Crime*, Cambridge, Cambridge University Press.
- [7] Arlacchi P., 1986. *Mafia Business: The Mafia Ethic and the Spirit of Capitalism*, London: Verso.
- [8] Bandiera, O., 2003. Land Reform, the Market for Protection, and the Origins of the Sicilian Mafia: Theory and Evidence. *Journal of Law, Economics, and Organization* , 19(1), 218-44.
- [9] Baron, J. H. (2009). *Sailors’ Scurvy Before and After James Lind - A reassessment*. *Nutrition Reviews*: 67(6):315-332.
- [10] Battaglia, R., 2003. *L’ultimo Splendore: Messina tra Rilancio e Decadenza*, Rubbettino Editore.
- [11] Benigno, F, and Ultra Pharum, 2001. *Famiglie, commerci e territori nel Meridione moderno*, Donzelli, Roma
- [12] Blok, A., 1975. *The Mafia of a Sicilian Village, 1860-1960: A Study of Violent Peasant Entrepreneurs (State and Revolution)*, Harper & Row, NY..
- [13] Bonfadini, R., 1876. *Relazione della Commissione Parlamentare, Inchiesta sulle Condizioni Sociali ed Economiche della Sicilia*, Roma.
- [14] Bottari, S., 2006. *The Port of Messina 1591-1783, Sulle onde del Mediterraneo*, Proceedings of the 2nd MMHM Conference.
- [15] Buonanno, P., Durante R., Prarolo G, Vanin P., 2015. “Poor Institutions, Rich Mines: Resource Curse in the Origins of the Sicilian Mafia”, *The Economic Journal*, 125, 175-202
- [16] Catanzaro, R., 1992. *Men of Respect: A Social History of the Sicilian Mafia*, New York: The Free Press.
- [17] Colajanni, N., 1885. *La Delinquenza della Sicilia e le sue Cause*, *Giornale di Sicilia*.
- [18] Colajanni, N., 1895. *Gli Avvenimenti di Sicilia e le Loro Cause*, Remo Sandrom, Palermo.
- [19] Colajanni, N., 1900. *Nel regno della mafia*, Remo Sandrom, Palermo.

- [20] Congdon Fors, H. and O. Olsson, 2007. Endogenous Institutional Change After Independence, *European Economic Review* 51(8), 1896-1921.
- [21] Conley, T.G., Hansen, C.B., McCulloch, R.E. and Rossi, P.E., 2008, A semi-parametric Bayesian approach to the instrumental variable problem. *Journal of Econometrics*, 144(1):276-305.
- [22] Cutrera, A., 1900. *La Mafia e i Mafiosi*, Palermo, A Reber.
- [23] Damiani, A. 1886. *Atti della Giunta per l'Inchiesta Agraria e sulle Condizioni della classe Agricola*, Forzani Tip. Del Senato tomo 2 fasc. 4 (Archivio Centrale Roma).
- [24] Di Vita, G., 1906. *Dizionario Geografico dei Comuni della Sicilia e delle Frazioni Comunali: Con Notizie Storiche*, F. Pravatà.
- [25] Dickie, J., 2004. *Cosa Nostra: A History of the Sicilian Mafia*, Palgrave Macmillan.
- [26] FAO/IIASA, 2010. *Global Agro-ecological Zones (GAEZ v3.0)*. FAO, Rome, Italy and IIASA, Laxenburg, Austria
- [27] FAO/IIASA Geonetwork- Geo-Spatial Data; <http://www.fao.org/geonetwork/srv/en/main.home>
- [28] Finley M.I., Mack Smith, D., Duggan, C., 1987. *A History of Sicily*. Elisabeth Sifton Books, Viking Penguin INC.
- [29] Fiorentini, G.; 1999. *Organized Crime and Illegal Markets*. Dipartimento di Scienze Politiche. Università' di Bologna' Wp 8400.
- [30] Franchetti, L., 1877. *Condizioni politiche ed amministrative della Sicilia Vol.I*, in *La Sicilia nel 1876*, Firenze, Barbera, 1877.
- [31] Fukuyama, F., 2000. *Social Capital and Civil Society*, IMF working paper WP/00/74.
- [32] Gambetta, D. and Reuter, P. 1995. Conspiracy among the many: the mafia in legitimate industries, in Fiorentini and Peltzman, Sam (eds), *The Economics of Organized Crime*, Cambridge, Cambridge University Press, pp.116-136.
- [33] Gambetta, D., 1996. *The Sicilian Mafia: the Business of Private Protection*, Harvard University Press.
- [34] Gambetta D., 2009. *Codes of the Underworld: How Criminals Communicate*. Princeton University Press.
- [35] Grossman, H. I., 1995. Rival Kleptocracies: The Mafia versus the State, in Fiorentini, G. and Peltzman, S. (eds.), *The Economics of Organized Crime*, Cambridge, Cambridge University Press.
- [36] Hardin, R., 1999. Social Capital. In Alt, James E., Margaret Levi, Elinor Ostrom: *Competition and Cooperation*. New York: Russell Sage Foundation, 170-189.
- [37] Hart, O. and J. Moore, 1988. "Incomplete Contracts and Renegotiation" *Econometrica*, 4(56), 755-785.
- [38] Hess, H., 1973. *Mafia and Mafiosi: The Structure of Power*, Farnborough: Saxon House.
- [39] Italian National Institute of Statistics - ISTAT, 1999. *Delitti Denunciati dalle Forze di Polizia all'Autorità Giudiziaria*.



- [40] Levi, M., 1996. Social and Unsocial Capital: a Review Essay of Robert Putnam's Making Democracy Work. *Politics and Society*, 24: 45-55.
- [41] Lupo, S., 1990. *Il Giardino degli Aranci*, Saggi Marsilio.
- [42] Lupo, S., 2011. *History of the Mafia*, Columbia University Press.
- [43] Mehlum, H., K-O Moene, and R. Torvik, 2006. "Institutions and the Resource Curse". *Economic Journal*, 116(508), 1-20.
- [44] Monroe, S. W., 1909. *The Spell of Sicily: The Garden of the Mediterranean*, Boston, The Page Company.
- [45] Montanelli, I., 1949. Interview with Don Calo Vizzini. *Corriere della Sera*, October 30.
- [46] NASA Ocean Biology Processing Group, <http://oceancolor.gsfc.nasa.gov/DOCS/DistFromCoast/>
- [47] Newton, K., 2001. Trust, Social Capital, Civil Society, and Democracy, *International Political Science Review* April 2001 vol. 22 no. 2 201-2.
- [48] Pescosolido G., 2010. *L'Economia Siciliana nell'Unificazione Italiana*, paper presented in the Convegno Nazionale di Studi: La Partecipazione della Sicilia al Movimento dell'Unificazione Nazionale.
- [49] Pezzino P., 1990. Una certa reciprocita' di favori. *Mafia e modernizzazione violenta nella Sicilia postunitaria*. FrancoAngeli.
- [50] Pizzuto Antinoro, M., 2002. *Gli Arabi in Sicilia ed il modello irriguo della Conca d'Oro*, Palermo: Regione siciliana, Assessorato agricoltura e foreste.
- [51] Powell, H. G., 1908. *Italian Lemons and Their By-Products*, Bulletin No. 160, Bureau of Plant Industry, US Department of Agriculture.
- [52] Putnam R., 1993. *Making Democracy Work: Civic Tradition in Modern Italy*. Princeton University Press. Princeton.
- [53] Reuter, P. (1987). *Racketeering in Legitimate Industries: A Study in the Economics of Intimidation*, Santa Monica, CA: The Rand Corporation.
- [54] Sala-i-Martin, X. and A. Subramanian (2003) "Addressing the Natural Resource Curse: An Illustration from Nigeria" *NBER Working Papers*, No 9804, NBER.
- [55] Sonnino, S. and Franchetti L., 1877. *La Sicilia nel 1876*, Firenze, Tip. di G. Barbera.
- [56] Skaperdas, S., 2001. The Political Economy of Organized Crime: Providing Protection When the State Does Not, *Economic of Governance* 2: 173-202.
- [57] Skaperdas, S. and Syropoulos, C. 1995, "Gangs as Primitive States", in Fiorentini, G. and Peltzman, S. (eds.), *The Economics of Organized Crime*, Cambridge, Cambridge University Press.
- [58] Stock, J. and M. Yogo (2005) "Testing for weak instruments in linear IV regression," in *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, Chap. 5, pp. 80i,  $\frac{1}{2}$ 108.

- [59] Traveyan, R., 2001. Principi Sotto il Vulcano. Storia e Leggenda di una Dinastia di Gattopardi Anglosiciliani dai Borboni a Mussolini, Milano BUR.
- [60] van der Ploeg, F., 2011. “Natural Resources: Curse of Blessing?” . Journal of Economic Literature 49(2), 366-420.
- [61] Villari, P., 1875. Lettere Meridionali, L’Opinione.

Figure 1: Model of mafia emergence

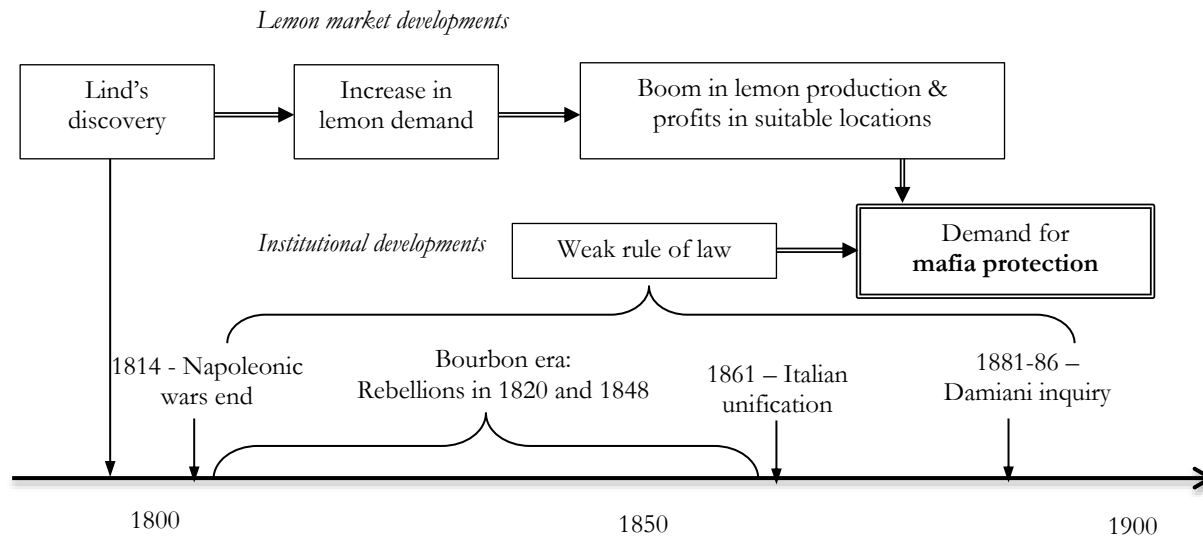
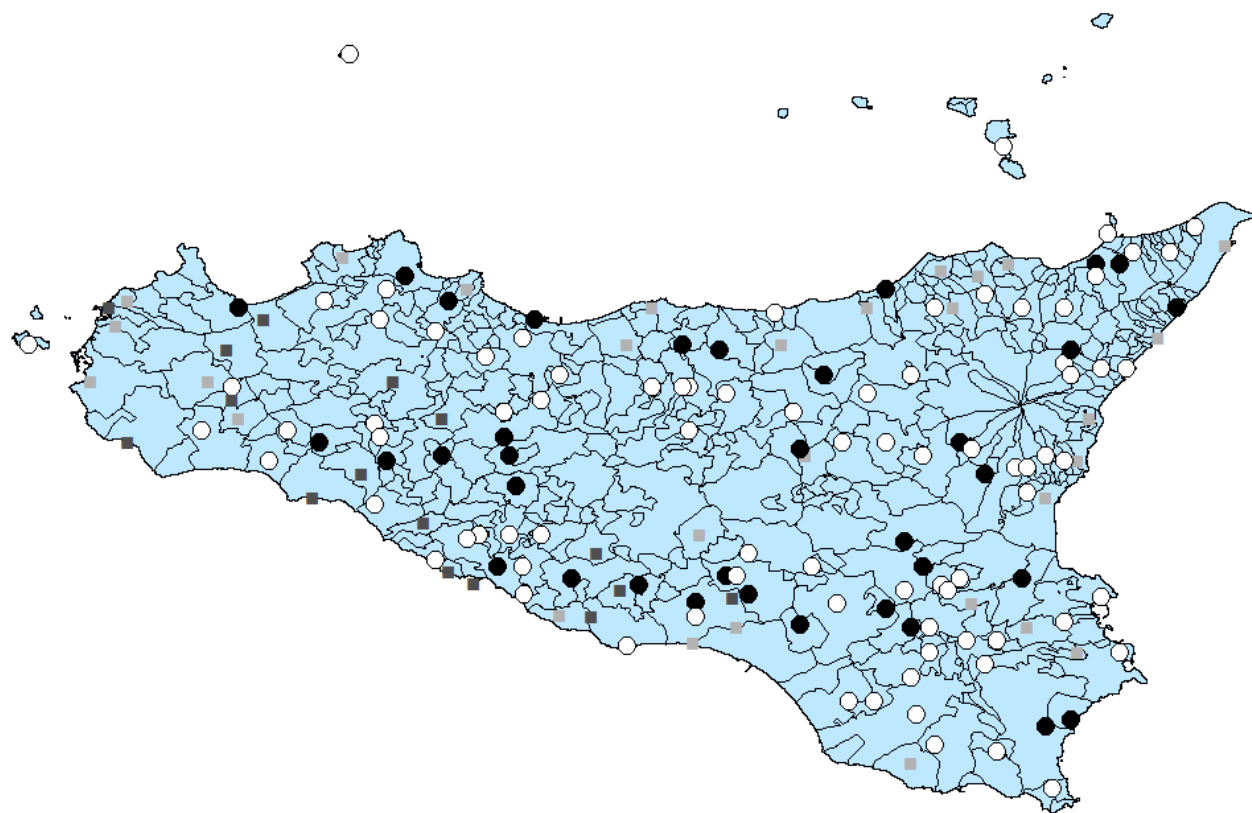
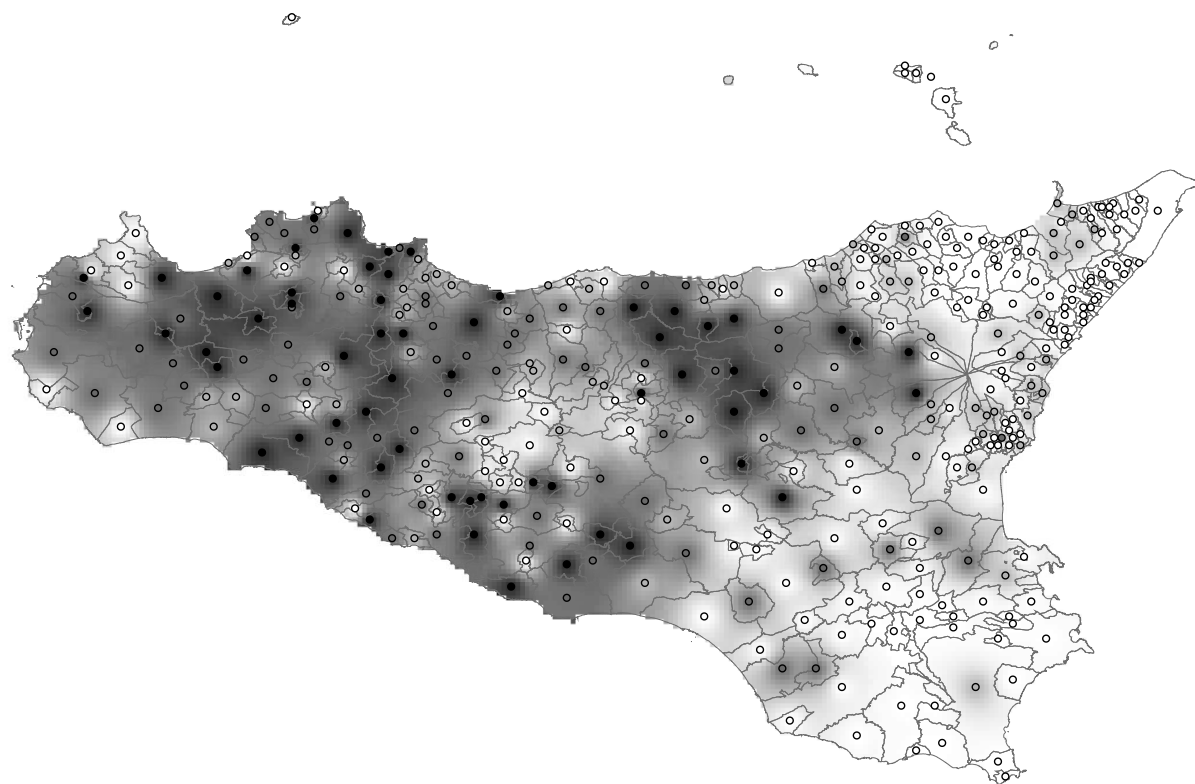


Figure 2: Mafia and non-mafia towns in Sicily in 1880s (Damiani sample)



Black circles represent municipalities with mafia and lemon production, white circles represent municipalities with no mafia and no lemon production, squares represents municipalities with no mafia and lemon production (light grey) and with mafia and no lemon production (dark grey).

Figure 3: Mafia interpolated using an IDW



Note: Circles denote municipalities with high intensity of mafia (black circles), average intensity (greyish circles) and no mafia (white circles). The intensity of mafia after the interpolation is denoted on a same scale from 0 to 3 with white areas denoting towns with no mafia and black areas denoting regions with high intensity of mafia. Source: Cutrera (1900)

Table 1: Exports of lemon juice and fragrances from the Harbour of Messina

	1834		1837		1839		1840		1850	
	Lemons (barrels)	Fragrances (pounds)	Lemons (barrels)	Fragrances (pounds)	Lemons (barrels)	Fragrances (pounds)	Lemons (barrels)	Fragrances (pounds)	Lemons (barrels)	Fragrances (pounds)
Austria	158	27,452	24	14,068	282	54,902	72	57,416		67,720
Belgium	121	6,680	4	600	8	6,810	39	7,700		
Denmark	102	2,200	10	130	25	715	27	1,650	102	4,700
France	164	9,744	139	6,452	110	34,604	373	33,968	1,472	355,187
Germany	120	10,685	20	2,800	2	11,550	37	4,530	384	12,400
Great Britain	210	24,795	385	28,108	504	31,216	640	47,217	8,626	84,450
Italy	409	21,150								
Malta			84				55			
Netherland		2,200		1,720			6	10,200	268	17,470
Prussia				250						
Russia		13,453	64	2,000	128	5,750	210	15,720	9,190	12,400
Sardinian State	157	9,132		1,390	14	7,408	4	6,950		
Sweden	114					800				3,000
Turkey	180	1,001	10		31		203			
Tuscany	12	1,300				864	16			
USA	3	6,080		400	1	5,250	15	13,134	256	46,700
Total	1,341	114,722	740	57,918	1,105	159,914	1,967	198,485	20,707	624,977

Source: Battaglia (2003).

Table 2: Total Italian exports of lemon and total United States imports

Year	Total Italian exports			Total US imports		
	Quantity (pounds)	Value (US \$)	Exports to the US (%)*	Quantity (pounds)	Value (US \$)	Imports from Italy (%)**
1898	325,504,061	3,419,486	41.3	133,374,95	2,521,985	100^
1899	359,473,041	3,234,489	36.7	298,634,448	4,399,160	44.1
1900	331,563,577	3,000,286	29	159,384,389	3,655,926	60.3
1901	368,801,294	3,328,610	29.2	148,334,112	3,516,877	72.5
1902	490,033,260	3,432,677	35.3	162,962,091	3,318,909	100^
1903	459,622,020	3,218,948	31.2	152,775,867	3,087,244	93.8

Notes:

\*Percentages provided by Powell (1908)

\*\* Percentages estimated using percentages on quantity exported from Italy above. For example for the year 1900 the quantity exported to the US is 331,563,577\*0.29=96,153,473 which divided by 159,384,389 provides a percentage equal to 60.32 per cent.

^ In 1898 and 1902 the percentage exported from Italy to the US exceeds the total import into the US. This is because Italian figures refer to the calendar year, while USA figures refer to the fiscal year.

Source: Powell (1908)

Table 3: Distribution of mafia and agricultural production across provinces in 1881-86

Province	Towns	Mafia	Dominant production of:				
			Citrus	Grape	Olive	Wheat	Sulphur
Caltanissetta	16	0.437	0.368	1	0.471	1	0.526
Catania	22	0.318	0.567	0.913	0.435	0.826	0.226
Girgenti	17	0.823	0.4	0.611	0.388	1	0.625
Messina	25	0.24	0.542	0.869	0.652	0.522	0.07
Palermo	27	0.296	0.517	0.777	0.444	0.74	0.133
Siracusa	21	0.142	0.429	0.9	0.5	0.8	0
Trapani	15	0.4	0.4	0.8	0.6	0.8	0.066
Total	143	0.357	0.474	0.839	0.497	0.797	0.23

Notes: Numbers in the table refer to the share of towns within each province with mafia presence and/or with dominant production of each commodity. Each variable in the table is a binary dummy. *Mafia*=1 if mafia is perceived to be the most common form of crime in the town and 0 otherwise, as explained in the text. *Citrus*, *Grape*, *Olive*, *Wheat* and *Sulphur* are also binary dummies taking on the value of 1 if the commodity is listed by the *pretore* as one of the key agricultural goods produced in the town, as explained in the text.

Source: Damiani (1886)

Table 4: Mafia OLS model

	Dependent variable: Mafia (in 1880)					
	(1)	(2)	(3)	(4)	(5)	(6)
Citrus	0.201** (0.086)	0.224*** (0.085)	0.225** (0.086)	0.213*** (0.076)	0.200** (0.078)	0.219*** (0.082)
Grape	0.030 (0.105)	0.136 (0.105)	0.124 (0.105)			
Olive	0.006 (0.091)	-0.037 (0.089)	-0.027 (0.092)			
Wheat	0.039 (0.095)	-0.028 (0.094)	-0.012 (0.095)			
Sulphur	0.198 (0.125)	0.022 (0.119)	-0.071 (0.127)			
Fractionalization Policies	0.271*** (0.085)	0.262*** (0.087)	0.242*** (0.087)	0.252*** (0.086)	0.247*** (0.088)	0.268*** (0.091)
Large Scale Plantation	0.251*** (0.090)	0.257*** (0.086)	0.283*** (0.086)	0.255*** (0.083)	0.258*** (0.088)	0.251*** (0.087)
Population Density					0.041 (0.079)	
High Land Fractionalization						0.072 (0.082)
Provinces Fixed Effects	No	Yes	Yes	Yes	Yes	Yes
R-squared	0.160	0.280	0.311	0.288	0.281	0.261
Observations	119	119	109	120	119	112
Provinces	All	All	Without Caltanissetta	All	All	All

Notes: The estimator is OLS in all specifications. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.



Table 5: 2-SLS estimates

Panel A		
Dependent variable: Mafia (in 1880)		
2 <sup>nd</sup> stage estimates		
Estimator	IV	IVPROBIT
Citrus	0.539** (0.210)	1.836*** (0.394)
Fractionalization policies	0.240*** (0.091)	0.828** (0.336)
Large scale plantation	0.220** (0.087)	0.750** (0.324)
Province dummies	Yes	Yes
Observations	120	120
R-Squared	0.171	
1 <sup>st</sup> stage estimates for Citrus		
Excluded Instrument: Mean Free-Frost Period	0.005*** (0.001)	0.005*** (0.001)
Anderson LR Statistics	20.39	
Cragg-Donald F-Statistics	20.372	
Stock and Yogo 10% critical value	16.38	
Partial F-statistics	22.14	
Endogeneity Test (p-values)	0.078	

Notes: The estimator is an IV in column 1, and IVPROBIT in column 2. We run a two-stage least square estimations with *Citrus* as the endogenous variable and mean free-frost period as the excludable instrument. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 6: Mafia intensity and citrus suitability

	Dependent variable:				
	Mafia intensity (Cutrera)			Mafia intensity (IDW)	
	Oprobit	OLS	Spatial OLS	OLS	Spatial OLS
	(1)	(2)	(3)	(4)	(5)
Citrus Suitability (Rain Fed)	2.762** (1.137)	1.816** (0.788)	1.816*** (0.357)	1.156*** (0.440)	1.156*** (0.348)
Olive Suitability (Rain Fed)	0.216 (1.252)	0.181 (0.966)	0.181 (0.927)	0.424 (0.538)	0.424 (0.658)
Wheat Suitability (Rain Fed)	1.281 (1.380)	0.808 (1.015)	0.808 (0.927)	-0.442 (0.570)	-0.442 (0.741)
Grape (dummy)	0.077 (0.235)	0.014 (0.173)	0.014 (0.106)	0.000 (0.106)	0.000 (0.058)
Sulphur (dummy)	0.228 (0.235)	0.161 (0.175)	0.161 (0.181)	0.070 (0.107)	0.070 (0.092)
Distance from the Coast	-2.521*** (0.483)	-1.721*** (0.351)	-1.721*** (0.505)	-1.214*** (0.194)	-1.214*** (0.257)
Soil Productivity	-0.068 (0.595)	0.014 (0.395)	0.014 (0.379)	0.135 (0.212)	0.135 (0.216)
Altitude	0.876 (0.830)	0.566 (0.594)	0.566* (0.293)	0.432 (0.292)	0.432* (0.230)
Precipitation	-3.356** (1.458)	-2.165** (1.040)	-2.165** (0.875)	-1.642*** (0.617)	-1.642** (0.768)
Inland Water (Basin)	-4.487*** (1.096)	-2.478*** (0.638)	-2.478*** (0.540)	-0.714** (0.316)	-0.714*** (0.245)
Land Nutrients	-0.180 (0.804)	-0.107 (0.496)	-0.107 (0.401)	-0.201 (0.239)	-0.201 (0.224)
Land Workability	1.209* (0.729)	0.875* (0.524)	0.875*** (0.193)	1.100*** (0.287)	1.100*** (0.149)
Province dummies	Yes	Yes	Yes	Yes	Yes
R-squared		0.420	0.809	0.665	0.906
Observations	235	235	235	280	280

Robust standard errors in parentheses for (1), (2) and (4). Conley (2008) robust spatial standard errors in parentheses for column (3) and (5). Distance cutoff in (3) and (5) equal to 20 km. We tried different cutoff levels and standard errors decreases when we increase the cutoff. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table A1: Distribution of land (hectares) devoted to citrus in South Italy between 1853-1885

<b>Provinces</b>	<b>1853</b>	<b>1885</b>
Palermo	2912	6458
Messina	2762	7743
Catania	566	7628
Siracusa	424	2609
Other	1027	2606

Total	7691	26844
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Table A2: Exports from the harbor of Messina in 1850

Product	Quantity	Units	Lire	Description
Silk	1,100	Balle	4,469,850	Oz 645 x Balla
Olive Oil	320,000	Cafissi	2,419,200	Approx 3 Litres x Cafisso
Oranges	500,000	Casse	2,726,325	Approx 240 oranges x cassa.
Lemons	600,000	Casse	3,779,622	Approx 360 lemons x cassa
Lemon Juices	1,000	Barili	503,986	Oz 40 per barile
Salted Lemons	200	Barili	151,200	Oz 6 per barile
Citrus Perfumes	400,000	Libre	2,014,740	
Sulphur	90,000	Quintali	302,211	
Wheat	50,000	Salme	2,477,790	
Flax	20,000	Salme	1,007,937	4 salma = 2 hl
Wine	2,000	Salme	37,800	1/2 salma= 801 hl
Nuts	4,000	Salme	655,169	4 salma = 3 hl
Almond	20,000	Cantaia	1,763,370	Oz 7 x cantaio
Pistachio	200	Cantaia	30,240	Oz 12 x Cantaio
Walnuts	2,000	Salme	50,387	4 salma = 3 hl
Liquorice	16,000	Cantaia	680,400	Oz 9 per cantaio
Sardines	4,000	Barili	151,162	Oz 2 per Barile
Carob	4,000	Sacchi	90,720	24 sacchi = 90Kg
Wool	2,000	Cantaia	453,600	6 cantaio = 80Kg
Linen	7,000	Quintali	264,600	Oz 3 x quintali
Cotton	4,000	Quintali	30,240	

Source: Battaglia (2003)

Table A3: Descriptive statistics for political organization across provinces before the Italian unification in 1860

Province	Towns	Political organization:			
		Feudal	Crown-ruled	Church-ruled	Frac. policies
Caltanissetta	12	0.833	0.167	0	0.714
Catania	31	0.452	0.29	0	0.625
Girgenti	24	0.583	0.125	0	0.714
Messina	28	0.357	0.28	0.214	0.285
Palermo	30	0.566	0.267	0.133	0.346
Siracusa	22	0.818	0.181	0	0.5
Trapani	15	0.666	0.333	0	0.285
Total	162	0.574	0.216	0.0617	0.413

Numbers in the table refer to the share of towns within each province that were characterized by feudal organization, was crown- or church-ruled, or had a substantial degree of fractionalization policies. Each of the variables of Political organization is a binary dummy.

Source: Damiani (1886)

Table A4: Land fractionalization and scale of plantations by province in 1881-86

Province	Towns	Fractionalization of ownership		Scale of plantation	
		High	Low	Large	Small
Caltanissetta	12	0.545	0.454	0.333	0.5
Catania	23	0.409	0.227	0.26	0.695
Girgenti	14	0.461	0.461	0.357	0.461
Messina	20	0.277	0.444	0.35	0.789
Palermo	26	0.52	0.16	0.461	0.576
Siracusa	20	0.35	0.5	0.35	0.666
Trapani	14	0.333	0.333	0.285	0.923
Total	129	0.413	0.347	0.348	0.661

Numbers in the table refer to the share of towns within each province that were characterized by high or low fractionalization in land ownership and large or small plantations.

Source: Damiani (1886)

Table A5: Descriptive statistics for robustness analysis

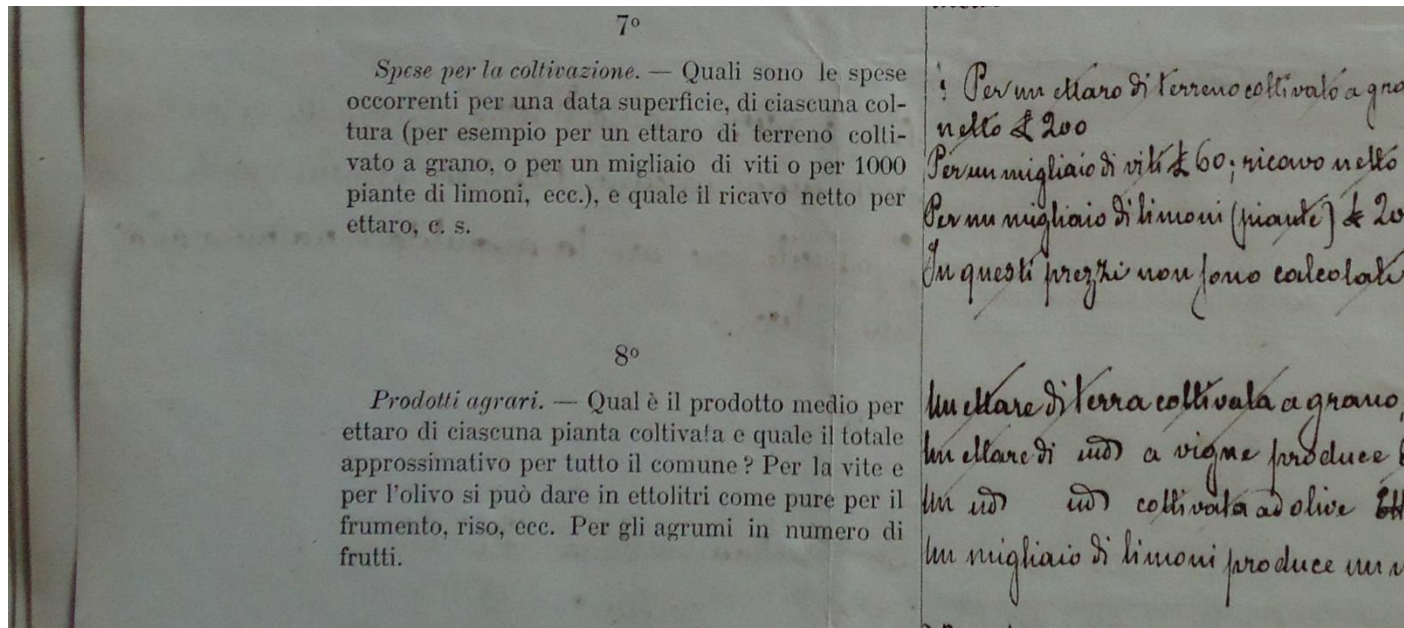
Variable	Obs	Mean	Std. Dev.	Min	Max
Mafia intensity (Cutrera, 1900)	289	1.435986	1.128953	0	3
Mafia intensity (IDW interpolation)	391	1.264872	0.9225032	0	2.956452
Citrus suitability	382	0.3487664	0.1362065	0	1
Olive suitability	391	0.65047	0.2441069	0	1
Wheat suitability	391	0.5571812	0.2065363	0	1
Sulfur (Dummy)	380	0.1368421	0.3441337	0	1
Grape (Dummy)	359	0.8857939	0.3185054	0	1

Table A6: OLS regressions with additional controls

	Dependent variable: Mafia (in 1880)				
	(1)	(2)	(3)	(4)	(5)
Citrus	0.203** (0.079)	0.213*** (0.078)	0.197** (0.085)	0.264*** (0.078)	0.233*** (0.087)
Fractionalization Policies	0.241*** (0.086)	0.232*** (0.087)	0.259*** (0.094)	0.273*** (0.088)	0.249** (0.103)
Large Scale Plantation	0.260*** (0.084)	0.266*** (0.083)	0.262*** (0.088)	0.247*** (0.084)	0.154 (0.098)
Distance from Palermo (in log)	-0.070 (0.072)				
Distance from Mazzaro del Valle (in log)	-0.036 (0.092)				
Feudal		0.039 (0.090)			
Distance from the Railway			-0.035 (0.029)		
Not Care of Law (dummy)				0.213 (0.134)	
Mistrust in Law (dummy)				0.225 (0.218)	
Trust in Law (dummy)				0.095 (0.093)	
Length of Contract (in log)					-0.134** (0.056)
Province dummies	Yes	Yes	Yes	Yes	Yes
Observations	120	118	113	113	101
R-squared	0.285	0.292	0.268	0.303	0.248

Notes: The estimator is OLS in all specifications. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Figure A1: Costs and Profits per Crops



The figure reports costs and profits (question 7) for wheat (first row), grape (second row), and citrus (third row) for a typical municipality from the Damiani Inquiry. Costs for wheat are 88.40 Lire and the Profit is Lire 200. Costs for grape is Lire 60 and profit is 50 Lire. Costs for citrus is Lire 2000 and the profit is Lire 14,000.

Figure A2: Variables in the original Inquiry Damiani (1886) related to mafia

Scostumatezza	Religiosità	Clero	False	Reati	Vagabondaggio
Adulterio incesto nascite illegali varie	religiosi depositi	corrotti esemplari	perjurii falsi	Quali in quale misura prevalgono cause	accattonaggio

Note: Figure A1 shows a picture of the second part of the table from which we got data on mafia. The first row reports variables. Starting from the left, the first variable is Scostumatezza (lewdness). There are three possible causes among which the prefect can choose. The first one is Adulterio (adultery), the second Incesto (incest), the third is Nascite Illegali (illegally born child), and the last one is Varie (various). The second variable relates to the religiousness of people in the town, the third one relates to the clergy (corrupt or exemplary), and the fourth variable regards perjury. The last variable is Vagabondaggio accattonaggio (vagrancy and begging). The fifth variable is the one we use to get information on mafia. The variable is labelled Reati (crimes) and then it is asked what the most common crimes are and the extent of these crimes. Most of the time, pretori only answered providing information on the sort of crime committed. The most common forms of crime were rustling, mafia, bloody crimes, and bloody crimes for passion. In addition poverty was described as the most common cause of crime.



Figure A3: Inchiesta Agricola (Agricultural Inquiry) in Damiani (1886)

Provincia di Palermo  
Comune di Cefalù

PARTE I

Condizioni dell'Agricoltura.

NB. Le risposte ai quesiti saranno tanto più gradite quanto più concise e particolareggiate.

(1) Quesiti.	Risposte.
<p>1°</p> <p><b>Territorio.</b> — Qual è la superficie del territorio di codesto comune in ettari.</p> <p>In quante zone agrarie può suddividersi il territorio? Qual è approssimativamente l'estensione di ciascuna?</p>	<p>La superficie del territorio di Cefalù è di Ett. 52,943,492.</p> <p>Esso si divide in tre zone: marina (pianura), montagna (colline), montagna.</p> <p>La prima ha l'estensione di Ett. 2,500,000 circa, la seconda di Ett. 20,000,000 circa, la terza di Ett. 30,443,492 circa.</p>
<p>2°</p> <p><b>Terreno.</b> — Caratteri fisici e chimici del terreno in generale (se sciolto, tenace, umido, torboso, arido, sabbioso, ciottoloso, ecc. o calcareo argilloso, siliceo).</p> <p>Indicare se si riscontrano diverse qualità di terreni, se queste sono egualmente distribuite; se negativamente accennare le qualità predominanti.</p>	<p>La composizione chimica del terreno è dominata generalmente dal calcareo; oppure nei boschi e in alcune parti predomina la silice, come in alcune poche parti predomina l'argilla.</p>

Note: Figure A2 shows the first page of the Agricultural Inquiry for the city of Cefalu. The column on the left reports the question (Quesiti). The column on the right reports the answer of the mayor. For example the first question asks “What is the surface area of the city”, “In how many areas the territory can be divided?” and “What is the extent of each area?” The mayor answers that the surface land of Cefalu is 52,943,492 sq.mt. and the territory is divided in three zones: 1) plain; 2) hills; 3) mountains. The first zone extends for almost 2,500,000 sq.mt.; the second for almost 20,000,000 sq.mt.; and the third for almost 30,443,492 sq.mt. The second question relates to the physical and chemical characteristics of the territory. This first part of the inquiry which is titled the Condition of Agriculture also reports information on the kind of crops produced, the sort of manufactures developed in the city, and so on. The second part of the Inquiry relates to the relationship between peasants and landlords, while the third part regards the moral conditions of peasants.

Figure A4: Cutrera's map



Figure A5: Mayor of Bisacquino Arguing that Citrus are in short supply because of the cold climate and frost.

<div>8°</div> <div><div>Prodotti agrari. — Qual è il prodotto medio per ettaro di ciascuna pianta coltivata e quale il totale approssimativo per tutto il comune? Per la vite e per l'olivo si può dare in ettolitri come pure per il frumento, riso, ecc. Per gli agrumi in numero di frutti.</div><div><i>Gli agrumi sono in poca quantità a causa del clima freddo e dei geli, e danno poco frutto in media ogni anno, che si mantengono piccoli, da cinquanta a settanta frutti, in tutto da circa 450.</i></div></div>	
<div>Agricultural Products- What is the average product for each cultivation? What is the overall product for the town? For grape and olive quantities can be expressed in hectolitres; for citrus fruits in numbers.</div>	<div><i>The citrus fruits tend to be scarce because of the cold climate and because of the frost...</i></div>

Table A6: Variable descriptions

<b>Variables</b>	<b>Description</b>	<b>Source</b>
Mafia	Dummy variable for whether the pretori reports mafia as one of the most common form of crimes The relevant question in the Inquiry is: <u>What is the most important form of crime?</u>	Damiani (1886). Original surveys completed by pretori
Citrus, Grape, Olive, Wheat	Dummy Variable proxying the most important crop produced in the town. The questions in the Inquiry are: <u>Q5) What is the dominant crop in the town?</u> <u>Q8) What is the average yield per hectare of each cultivated plan and the total for the town?</u> <u>For the citrus what is the number?</u>	Damiani (1886). Original surveys completed by mayors excepted for the Province of Caltanissetta for which we use the summary Report (Damiani). Di Vita (1905) is used to integrate missing information in Damiani whenever possible.
Frost-Free Days	Average days without frost	FAO GAEZ
Sulphur mines	Dummy variable for whether there is sulphur mine.	Di Vita (1905)
Feudal, Church-Ruled, Crown-Ruled.	Dummy variable coding the political organization within the town before the Unification of Italy.	Di Vita (1905)
Scale of the Plantation	Dummy variable for the scale of the plantation. Question: <u>Is the large, medium, or the small scale of the plantation prevalent?</u> To be noticed that there is not a universal criterion to classify the scale. For example the mayor of Caltagirone considers large a plantation extending for more than 2000 hectares and small a plantation extending for less than 20 hectares. On the other hand the mayor of Paterno' considers large a plantation extending over 50 hectares and small one extending over less than 1 hectare. Most of the times this difference reflects the extent of the town. This difference is important because affects the answer on the fractionalization of land below	Damiani (1886). Original surveys completed by mayors excepted for the Province of Caltanissetta for which we use the summary Report (Damiani).
Fractionalization of Land	Dummy variable for the level of fractionalization of land. Question: <u>What is the fractionalization of the land and which factors have affected it?</u> As mentioned above this is affected by the classification of the scale of the plantation above	Damiani (1886). Original surveys completed by mayors excepted for the Province of Caltanissetta for which we use the summary Report (Damiani).
Fractionalization of Policies	Dummy variable coded one if policies aimed at increasing peasants' ownership have been effective in fractionalizing the land. Policies considered are: Enfiteusi, Abolishment of Feudalism, and Privatization of the church's assets. Question: <u>Which factors have affected the fractionalization?</u>	Damiani (1886). Original surveys completed by mayors excepted for the Province of Caltanissetta for which we use the summary Report (Damiani).

Altitude and Distance from the Railway	Altitude above the sea level (in metres) and distance in Km to the closer railway station.	Di Vita (1905).
Rule of Law	Dummy variable for the trust people have in the application of law. Question: <i>Do people trust, mistrust, care or fear the law?</i>	Damiani (1886). Original Surveys completed by pretori.
Length of Tenancy Contract	Question: <u>What is the average length of the tenancy contract?</u> In some cases the mayor reports that the contract lasts for the entire life. In this case we assume an average life expectancy of 60 years and an average duration of the contract of 40 years. We also try with different numbers (20, 30, 50 years) but results do not change.	Damiani (1886). Original survey completed by mayors exception made for the Province of Caltanissetta for which we use the summary Report (Damiani).
Mafia Crimes	Number of mafia crimes reported to the police which are punishable according to the 416bis article of the Italian Penal Law.	National Institute for Statistics - ISTAT (1999)
Assets Confiscated	Number of assets (i.e. apartments, buildings, etc.) confiscated from the mafia in the town.	Agenzia del Demanio (2008)
<b>Descriptions Variables for Section 6</b>		
Mafia Intensity	i) Ordinal Variable on a 0-3 scale ii) Interpolated using an Inverse distance weight matrix	Cutreria (1900)
Suitability to Crops (Citrus, Olive, Wheat)	Tons per Hectare (Agro-Climatic Suitability and Productivity in Tons per hectare)	FAO GAEZ
Altitude, Inland Water, Soil Workability Constraints, Soil Fertility.	These are measures of productivity and suitability of land to production	FAO GAEZ
Net Primary Production	It is an index of vegetation which depends on land moisture and temperature.	FAO GAEZ
Distance From the Coast	Spatial Data on the Distance from the Sea	NASA Ocean Biology Processing Group
Soil Neutrality	Soil pH. Generally an index around 6 (neutral) is the most suitable to production	FAO GEONETWORK